Changed Pages

Part III, Appendix III-D.5-1

Summary of Geotechnical Design Parameters

APPENDIX III-D.5-1

SUMMARY OF GEOTECHNICAL DESIGN PARAMETERS

8-15-2017

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Updates August 2017

Appendix III-D.5-1, Summary of Geotechnical Design Parameters

- Updated assumptions to match new landfill geometry
- Updated calculations to match new landfill geometry

APTIM	Client Name: Rancho Viejo Waste Management, LLC	
	Project Name: Pescadito Environmental Resource Center	Project No.: 148866
	Modified by: O.Covert	Date Modified: 8/1/17
	Reviewed by: P. Thomas	Date Reviewed: 8/7/17
TITLE: SUMMARY OF GEOTECHNICAL DESIGN PARAMETERS		

Problem Statement

Summarize the geotechnical design parameters for the various landfill and in-situ materials present at the Pescadito Environmental Resource Center Project Site.

References

The referenced literature cited below is provided in the attached pages. Referenced site specific information is provided within the Application as stated below.

1. The site Geology Report (dated 2015) contained in this Application — as it pertains to subsurface investigative data refer to Appendix III-E.2 of the Geology Report.
2. The site Geology Report (dated 2015) contained in this Application — as it pertains to geotechnical test data refer to Appendix III-E.3 of the Geology Report.
3. Design Drawings contained in this Application.
4. Holtz, R.D., and Kovacs, W.D. (1981). "An Introduction to Geotechnical Engineering." Prentice-Hall, 1981.
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6. Terzaghi, K., Peck, R.B., and Mesri, G. (1996). "Soil Mechanics in Engineering Practice." John Wiley and Sons Inc., 3rd Edition, 1996.
7. Bowles, J.E. (1996). "Foundation Analysis and Design." McGraw-Hill, 5th Edition, 1996.
8. Nixon, N., and Jones, D.R. (2005). "Engineering Properties of Municipal Solid Waste." *Journal of Geotextiles and Geomembranes*, 23(2005), 205-233.
9. Zekkos, D., Bray, J.D., Kavazanjian, E., Jr., Matasovic, N., Rathje, E.M., Riemer, M., and Stokoe, K.H., II (2006). "Unit Weight of Municipal Solid Waste." *Journal of Geotechnical and Geoenvironmental Engineering*, 132(10), 1250-1261.
10. Kavasanjian Jr., E. (2008). "The Impact of Degradation on MSW Shear Strength." *GeoCongress 2008*, 224-231.
11. Sharma, H.D., and Anirban, D. (2007). "Municipal Solid Waste Landfill Settlement: Postclosure Perspectives." *Journal of Geotechnical and Geoenvironmental Engineering*, 133(6), 619-629.
12. Bareither, C. (2008). "Compression Indices for Full-Scale Landfills." Compilation of Primary and Secondary Compression Indices from Literature (attached pages).
13. Interface Shear Test Results for various geosynthetic interfaces (attached pages).
14. USGS Seismic Hazard Map of the United States (attached pages).
15. USEPA (1993). "Solid Waste Disposal Facility Criteria Technical Manual." EPA530-R-93-017, November 1993.
16. The site Geology Report (dated 2015) contained in this application – as it pertains to subsurface investigative and geotechnical test data refer to Appendix III-E.5 of the Geology Report.

Assumptions

The landfill will include the following components as detailed below (**from top to bottom**):

- Final Cover System (4H:1V Slope)
  - 7-inch Vegetative Cover / Erosion Control Layer
  - 30-inch Infiltration Layer
  - 12-inch Intermediate Cover (Intermediate Cover is included as part of the Waste Layer for analysis purposes)
- Waste (maximum waste column thickness of approximately 241 feet occurring south of the peak final landform elevation)
- Leachate Collection / Liner System on 3H:1V Landfill <u>Sideslopes</u> (**Reference No. 3**)
  - *Protective Soil Layer (2-feet thick)*
  - *Geosynthetics - Option 1*
    - Geotextile Slip Layer
    - Double-Sided Drainage Geocomposite
    - 60-mil Textured HDPE Geomembrane
  - *Geosynthetics - Option 2*
    - Geotextile Slip Layer
    - Double-Sided Drainage Geocomposite
    - Bentonite Enhanced Textured FML (bentonite side faced down)
    - Bentonite Enhanced Textured FML (bentonite side faced up)
  - *Compacted Low Permeable Soil Liner ($k \leq 1x10^{-7}$ cm/sec)*
    - MSW Cells (2-feet thick)
    - Class I Waste Cells (3-feet thick)
- Leachate Collection / Liner System on Landfill <u>Base</u> (**Reference No. 3**)
  - *Protective Soil Layer (2-feet thick)*
  - *Geosynthetics - Option 1*
    - Double-Sided Drainage Geocomposite
    - 60-mil Textured HDPE Geomembrane
  - *Geosynthetics - Option 2*
    - Double-Sided Drainage Geocomposite
    - Bentonite Enhanced Textured FML (bentonite side faced down)
  - *Compacted Low Permeable Soil Liner ($k \leq 1x10^{-7}$ cm/sec)*
    - MSW Cells (2-feet thick)
    - Class I Waste Cells (3-feet thick)

Consolidation Parameters

The base liner will be entirely in the Stratum IV soils, with the approximate upper one-third of the sideslope liners in the Stratum III soils, and the approximate lower two-thirds of the sideslope liners in the Stratum IV soils. The consolidation parameters for settlement calculations were therefore only considered for the combined Stratum II-III-IV soil unit / layer. The consolidation parameters (compression index, recompression index, and secondary compression index) were calculated using empirical correlations between the various consolidation parameters and plasticity index. As stated earlier, an average plasticity index of approximately 36 was estimated for the combined Stratum II-III-IV soils (**Reference No. 2**). The consolidation parameters are summarized below in **Table 2**. Based on a review of laboratory test data/reports contained in **Reference No. 2**, an average void ratio (e_o) of approximately 0.64 was estimated and is presented below in Table 2 (later used in the foundation settlement calculations).

Table 2
Geologic Units
Consolidation Parameters

Geologic Unit / Layer	Void Ratio (e_o)	Average Plasticity Index	Compression Index (C_c)	Recompression Index (C_r)	Secondary Compression Index (C_α)
Stratum II-III-IV	0.64	36	0.4204	0.0609	0.0136

Notes:

1. Void ratio of 0.64 represents an estimated approximate average based on laboratory test data (**Reference No. 2**).
2. Compression Index (C_c) was calculated using the following correlation (**Reference No. 7**): $C_c = 0.046 + (0.0104 \times PI)$
3. Recompression Index (C_r) was calculated using the following correlation (**Reference No. 7**): $C_r = 0.00194 \times (PI - 4.6)$
4. Secondary Compression Index (C_α) was calculated using the following correlation (**Reference No. 7**): $C_\alpha = 0.00168 + (0.00033 \times PI)$

Overconsolidation Ratio

The overconsolidation ratio (OCR) was determined using an empirical correlation that utilizes natural water content (w_N), liquid limit (w_L), and the existing effective overburden pressure (p'_o) to determine the preconsolidation pressure (p'_c). The following empirical correlation was used based on **Reference No. 7**:

$$log_{10}p'_c = 5.97 - 5.32\left({}^{w_N}/_{w_L}\right) - 0.25\ log_{10}p'_o$$

Using an estimated average water content and liquid limit of approximately 17% and 58%, respectively for the Stratum II-III-IV soil unit (**Reference No. 2**), and calculating the overburden pressure at the landfill soil liner depth of 100-ft.bgs and an assumed depth of 50-feet below the liner (150-feet) for potential compressible soils, the preconsolidation pressure (p'_c) is solved for. The existing effective overburden pressure (p'_o) at 100-ft.bgs and 150-ft.bgs is 6,960 psf (333.25 kPa) and 10,440 psf (499.87 KPa), respectively. The preconsolidation pressure (p'_c) at 100-ft.bgs and 150-ft.bgs is 125,847 psf (6,026 kPa) and 114,763 psf (5,495 KPa), respectively. The OCR is then calculated as follows:

$$OCR = \frac{p'_c}{p'_o}$$

$$at\ 100\ ft.bgs = \frac{125{,}847}{6{,}960} = 18$$

$$at\ 150\ ft.bgs = \frac{114{,}763}{10{,}440} = 11$$

The native soil at liner depth and below is determined to be overconsolidated, since the OCR is greater than 1.0. The maximum effective overburden pressure that will occur on the native soils lying directly beneath the proposed compacted soil liner at the time of the complete build-out of the landfill will occur at the location of the maximum waste column thickness of 241. Using the unit weight of 65 pcf for waste fill (discussed on following page) and the thicknesses and unit weight of the final cover, protective cover, and compacted soil liner (total thickness = 3+2+3= 8-ft, and unit moist weight = 129 pcf), the effective overburden pressure (p'_{final}) at the time of complete landfill build-out is:

$$p_{final} = (241ft\ waste \times 65\ pcf) + [(8)ft\ soil\ layers \times (129)pcf] = 16{,}697\ psf$$

The estimated effective overburden pressure of 16,697 psf is significantly lower than the effective preconsolidation pressure (p'_c = 125,847 psf) acting on the native soil at liner depth; and therefore it is assumed that the native soils that will underlie the proposed landfill soil liner will be incompressible for purposes of foundation settlement calculations (**Appendix III-D.5-4**).

Material Properties of the Final Cover System

The landfill final cover will consist of 37-inches of the Stratum II-III-IV soils (as discussed earlier, 7 inches vegetative cover and 30 inches infiltration layer). The final cover is assumed to perform as a water balance cover and therefore will not have a geosynthetic barrier layer. For simplicity, the final cover system soil layers were modeled as one unit in the stability calculations. A summary of the unit weights and shear strength parameters are presented on **Table 3** on the following page.